The Great River, Master Sculptor

Percival Robertson

Above Mount Radiance, Elsah, Illinois

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by

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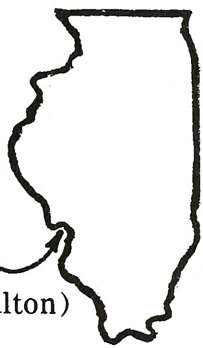

Area Discussed
(Grafton, Elsah, Alton)

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To Frederick Oakes Sylvester, whose vision of the Great River helped me to see.

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PROLOGUE

Once upon a long time ago two little fossils lived in the bottom of a clear shallow sea, not far from here. Said the trilobite to the crinoid, "We will not survive here very long but perhaps, just perhaps, the shells we now produce will become durable rock and possibly, just possibly, the rock thus formed will be carved by some mighty sculptor to form a scene whose beauty and majesty may inspire those who see it to loftier ideals." Perhaps, just perhaps, we too may have visions. But do not be disturbed if the visions are slow in becoming substantialized. Those two little fossils in this area had to wait over two hundred and fifty million years for their dream to come true. But it did come true, eventually. That is what this is all about.

P. R. Elsah, Illinois

THE GREAT RIVER, Master Sculptor

This mighty Mississippi, well called The Great River, with its palisaded course past Elsah and The Principia College campus has inspired those who have seen it and will continue to inspire others. It expresses beauty, grandeur, silent power, order.

How did all this come about? Has it always been like this? Is it a static entity? Or is there a dynamic force accomplishing a purpose?

To mere humans who view time from a paltry standpoint of three score years and ten, the bluffs may appear changeless. But to others who can see further and more deeply, they present a cinema of everchanging loveliness.

What one now sees in the fifteen miles along the river from Grafton to Alton is a bluff of white limestone from 100 to 250 feet high overlaid by a frosting of brown silt ranging up to 40 feet in thickness. The bluffs are interrupted occasionally by small stream valleys, most of which are quite narrow; but Piasa Creek's valley exceeds a mile in width. In one of the narrower valleys nestles the tiny village of Elsah.

What produced this whole vista? The geologist who has studied it will try to tell you. In this short paper it will be impractical to tell just how he comes to each conclusion, but he will try to give the evidence in some cases where it is practical. But if one desires to check all the statements made, he will have to study geology and learn to read the hieroglyphs nature has engraved on the landscape.

To start with, the river itself has sculptured these bluffs. At one time this region was a broad plain with an elevation approximating the top of the limestone part of the bluffs. A river, the ancestor of the present stream, flowed across the plain.

One viewing the river under normal conditions may find it difficult to believe that same river was capable of so much erosion. But when one sees, as in the great flood of April-May, 1973, the widespreading waters, the racing current, the power of persistent running water, it is easier to comprehend. Running water is a magnificant sculptor possessed of unlimited patience, perseverence, and skill. Through

many millennia slowly, ever so slowly, the river carved the obdurate limestone.

Furthermore, drillings made in the river bed before the dam at Alton was constructed penetrated 200 to 250 feet of sand and mud before bed rock was encountered. The river must have cut a canyon at an earlier time about 450 feet deep, half of which is now filled with sand and silt below the water surface.

Now all this took a very long time. It started many millennia ago. What evidence is there that this occurred? Shall we see what is going on now?

If one dips up a pailful of river water and lets it settle, he will find a layer of brown silt on the bottom which is identical to the silt on the top of the bluffs. The river is now carrying that silt from all the region around about and depositing it in the Gulf of Mexico, thereby ever extending its delta.

From studies made by engineers I once calculated how much solid material the river was actually carrying. One continuous line of freight cars from here to the Gulf of Mexico, each loaded to capacity and moving at an average speed for a freight train could not move that much solid material. Not one train but six such solid trains of cars would be needed to transport what the river now moves past Elsah constantly.

Some of the limestone of the bluffs has been removed in the same way as the brown silt. Rain water or river water will dissolve limestone, but you can't see it in the water any more than you can see salt in the ocean. Water that contains dissolved limestone is said to be hard. By that is meant that when such water is used with soap, a thick, slimy scum will be formed.

The water works of Alton, which supplies the community with drinking water, removes about one half of the hardness, that is half of the dissolved limestone. But the water we drink and wash with is still hard. Examine the inside of a tea kettle that has been used in this area for some time. You will find a solid deposit identical in composition with the limestone. Chemists call the material calcium carbonate, mineralogists call it Calcite. All cities along the Mississippi have the same problem of having to use hard water as their source of water supply.

A question repeatedly asked is: "If the river carved out the bluffs, why isn't there a corresponding bluff on the other side of the river?"

The answer is: there is such a bluff on the other side of the valley which the river made, but right here at Elsah, that valley is very wide, about 15 miles actually. When on a clear day one looks from the top of the bluffs at Elsah across the river, across the fertile farmland beyond, one can discern a line of low hills surrounding that farmland. These hills are the bluffs on the other side. They are not as steep as the bluffs at Elsah because the rocks there are not made of limestone but largely of shale that does not form vertical cliffs in a climate such as ours.

Now comes the question, from the mind which seeks primal cause, "What made the limestone? Was it always here?" To answer that we have to develop an idea already implied. The geologist tries to discover cause and effect relations as they exist today, and see how they apply to the past. In what we have just considered, the river carrying silt and dissolved limestone is the cause. It has long been removing the same sort of material as it is now moving. The bluffs represent the edges of the excavated part. They are the effect of the river's erosion.

When we examine the limestone, we find in it fossils looking quite similar to animals living in the sea today. Study convinces us that these fossils are the distant ancestors of the animals in the sea now. In parts of our present seas we find beaches made of shells and ground up fragments of shells. The limestone here is also composed largely of shells and ground up fragments of shells. We deduce that the sea once covered this vast plain. When I say "once" I am not thinking of a million years ago but hundreds of millions of years ago.

It has been estimated by many competent observers that about six hundred million years have elapsed since the first rocks containing abundant, easily recognizable fossils were formed. Such figures stretch the imagination!

In some Bibles, a chronology of events has been printed dating creation as 4004 B.C. This estimate was made by Archbishop Usher in 1654 based on a misinterpretation of

certain statements in Genesis. Some people have been influenced by his work but the evidence clearly indicates he was misled.

In considering such vast intervals as six hundred million years I've tried to aid the imagination. Suppose we were living at a vastly faster rate than our present fast pace. I'm suggesting a pace where all the events of an entire year would be crammed into two minutes. That would mean that if one were born at the very start of an average college class, he would be twenty-five years old, or more, when the class was dismissed.

Approximately six hundred million two-minute intervals have elapsed since the beginning of the Christian era; that shows that all that has occurred since fossils appeared could have been crammed into the Christian era at that enormously accelerated rate of one year to two minutes. Does that give a glimmer of how long six hundred million years is?

And yet these fossiliferous sediments are not the oldest rocks. Still older ones, almost devoid of signs of living organisms, have been found, but not at the surface in this area. Such rocks have been encountered near here only in wells many hundreds of feet deep.

Careful measurements have been made on some of these older rocks and the very oldest ones that have yet been studied are believed to be about four and one half billion years old. These oldest rocks will not be considered here as they are not to be seen locally.

Figure I will show how the geologist organizes this vast interval. The earliest rocks are naturally placed at the bottom of such a chart as they were formed first. So one reads a geologic chart in chronological order from the bottom upward.

The solid sedimentary rocks of this area were formed in what the geologist calls the Paleozoic era. The rocks composing most of the bluffs from Alton almost to Grafton were deposited in that part of the Paleozoic era called the Mississippian period. At Grafton, several miles west of Elsah, there is a layer from six to eight feet thick of rocks of

Figure I	Divisions of Geologic Time mentioned in this paper		
Millions of years ago	Era	Period	Where found locally
0.0	Cenozoic	Ice age	Tops of bluffs
		5 more	Not found locally
63	Mesozoic	3 periods	Only small exposures in southern tips of Illinois and Missouri
230	Paleozoic	Permian	Not found locally
		Pennsylvanian	Central Illinois, and near Godfrey
		Mississippian	Mississippi River bluffs
		Devonian	Grafton
		Silurian	Grafton
		Ordovician	Marquette State Park
		Cambrian	Only in deep wells locally
	Fossils common above this line, rare below		
600	Pre-Cambrian		Only found in deep wells locally Exposed in Ozark Mountains
4,500 - or -	Beginnings of geologic history		

Devonian age, while the rocks forming the quarry face at Grafton are of Silurian time.

At Pere Marquette State Park ten miles upstream from Elsah, there is an interesting geologic structure which shows a small exposure of rocks dating back to the Ordovician period.

The nearest Cambrian rocks at the surface are in the Ozarks. Near Elsah Cambrian rocks are encountered only in deep wells.

The bluffs at Elsah are made mostly of limestone formed in shallow seas during the Mississippian period. During the subsequent Pennsylvanian period seas for the most part withdrew from this area and widespread swamps with sluggish streams replaced them. Luxuriant vegetation everywhere was changed by slow geologic processes to the coal we now burn. Much of central Illinois was covered by these swamps. The nearest exposure of the coal formed at this period was near the National supermarket at the corner of Godfrey Road and Delmar Avenue at the boundary of Alton and Godfrey. A small, privately owned mine was visible there during the late 1930's. The mine had long been abandoned.

One should not think that a single sea invaded the area of the Mississippi valley during all the Paleozoic period. Rather, this whole area has been repeatedly submerged. The geologist studies the hiatuses when seas withdrew and land appeared, only to be submerged again. I'm not an expert on this subject, but I once counted thirteen sets of emergences and submergences from the cuttings in a deep well that was drilled near here at Dow, Illinois.

After the seas and swamps of the Mississippian and Pennsylvanian period withdrew, there were no more invasions of seas in this part of the country. Seas covered other parts of western America, but nearly all of Illinois and Missouri remained dry land.

During this long interval of about two hundred and fifty million years, erosion by stream flourished locally. You can see that there was plenty of time for the Mississippi River to produce its five hundred feet deep canyon.

But during this long interval while quiet erosion was the principal activity in this part of the country, there were vastly impressive events that occurred elsewhere. First in this interval the Appalachian Mountains were formed in the east by great folding and crumpling of sedimentarious strata. Still later other gigantic forces produced the various mountain ranges of the west.

Illinois and Missouri felt very little of these titanic forces, but in a few places there were minor movements of rock strata near here. A short distance north of the entrance to Pere Marquette State Park may be seen rocks that are tilted. These represent some of the local rock movement that occurred during one of the gigantic mountain building eras to the east and to the west of us.

About one million years ago climatic changes occurred. In fact, a series of climatic changes was brought about. The atmosphere chilled, and great ice sheets moved from the north down over the area to where Elsah now stands. Four ice sheets spread over northern North America. Of these, the fourth, the last one, did not reach this far south. Evidence that the first one reached the vicinity of Elsah is inconclusive, but the second and third certainly did.

Those who have visited glaciated areas in New England and westward in Ohio or Wisconsin may have seen what have been called moraines and other geological features of landscape. Such individuals may wonder why no such topography can be seen here. The answer is just this: the third ice sheet, the last one to reach this area, melted off at least two hundred thousand years ago. Although that interval is short in comparison to intervals that we have previously considered, still it is long enough for erosion to have greatly altered, in fact almost to have eliminated, the characteristic shapes of the glacial deposits formed.

The evidence that the third ice sheet did reach almost to Elsah but probably did not quite cover it can be seen. In upper Mill Creek about three miles from the village of Elsah a large granite boulder, transported by ice from a far northern location, was found. It now lies outside the geology area of Watson laboratory on The Principia College campus. And in the geology laboratory one can see the tusk of an ice

age mastodon that was found in the same general area by Dr. Dorothy Gore, a geologist and longtime Elsah resident.

Other less conspicuous deposits show ice may have reached the extreme northern edge of the college property, but not the top of the bluffs. There is a small stream valley that rises near the Hay Field House on the Principia College campus. If one will follow it northward and eastward to the place where it empties into Mill Creek, one may pass an exposure on one side of the stream that shows fine gravel, and a blue clay, which indicate deposits near the face of a glacier. If one starts to look for this, he need not be disappointed if he cannot find it. Some years that stream is active and undercuts its bank and the exposure is very clear, and at other times the deposit becomes entirely covered.

One other event closes the momentous geologic history of this quiet retreat. As the various ice sheets melted, great quantities of muddy water filled the lower half of the Mississippi canyon, and it spread a great blanket of fine silt over all the floor of the wide Mississippi flood plain. One standing on our bluffs at that time looking southward would have seen an area fifteen miles wide covered with silt and fine sand, but with no vegetation. Winds blowing from the southwest must have raised great clouds of dust and silt far greater than the dust storms of the 1930's of this century. This dust settled on the tops of our bluffs forming the deposit of fine brown silt about forty feet thick that covers the bluff tops and spreads eastward making the soil of our valued farmland. The geologist calls this wind-blown silt "loess," pronounced Luss. It spread westward also, but to a less extent.

Mississippi River from Chautauqua toward Elsah

To summarize this brief geological history of our area, we might borrow from Tennyson's IN MEMORIAM:

> There rolls the deep where grew the tree.
> Oh earth, what changes hast thou seen!
> There where the long street roars has been
> The stillness of the central sea.
>
> The hills are shadows, and they flow
> From form to form, and nothing stands;
> They melt like mists, and the solid lands,
> Like clouds they shape themselves and go.

We have traced the story showing how simple little living creatures produced the limestone, the raw material used by a sculptor. We have shown how ever so slowly the Great River carved the raw material producing the magnificant bluffs which are now an inspiration to all beholding them. Is not the river a grand sculptor? No! No! That does not trace back to fundamental cause. The river was but the carving tool used by the Master Sculptor to carve that beauty.

But as the bluffs were carved, the river picked up the chips, the mud, and all the waste material and carried them away.

Some individuals looking at the Mississippi today see only the muddy river. Frederick Oakes Sylvester, poet, and painter of the Great River, and former Principia teacher, saw much more. He wrote:

> The river they claim is turbid and dark,
> The river is grimed and gray,
> But I have seen a crown of gold
> On its head at the close of day.

It was Sylvester who first opened my half-closed eyes to the grandeur of the river. I, too, have seen the golden crown at sunset. And I have also seen the wonderful blue of the noonday, a blue that to me is the characteristic color of the river. I, too, have seen all the other tints, the wonderful rose,

the lavender, the mauve and the translucent aqua of the mist of the ever changing day all expressed in the river. This river is not alone the sculptor's tool; it is the painter's pallet, Nature's mirror.

I have come to realize that when we can see the Great River performing all its fundamental function, reflecting all the glories of the heavens, we don't see the mud in it any longer.

There is a tradition that says that the Danube is blue when one is in love. The same may be true for the Mississippi. One may not necessarily be in love with an individual. I believe Sylvester was in love with the Great River. And I believe also that if anyone can see as Sylvester did, he will find that the river is blue and he too will be in love with it.

....

The two appendices following are for those who desire a little more detailed geological information concerning the classification of local rocks and some common fossils to be found in them.

Appendix I. Local Rock Formations

Geologists recognize several subdivisions in the rocks in each period. These subdivisions are called formations. Figure II shows the principal rock formations found locally.

When the word "formation" is used in describing sedimentary rocks, it refers to a layer which may be several hundreds of feet thick or only a few inches, but it has great horizontal dimensions, usually many miles, and it is describably homogeneous.

These are the varieties of sedimentary rocks found in this area:

Sandstone (Ss.) Composed of compacted grains of sand.

Shale (Sh.) Occurs in thin layers. Shale is made of the same minerals as clay, and weathers into clay when exposed to air.

Limestone. (Ls.) Described elsewhere in this paper. Its mineral composition is Calcite. It appears to be largely, but not entirely, derived from shells.

Dolomite. (Dol.) This resembles limestone and does not need to be differentiated from it for most tyros. If one wants to go into fine points, one may distinguish limestone from dolomite by an acid test. A drop of acid at ordinary air temperature will effervesce (bubble) if dropped on limestone, but not on dolomite. However if the acid is heated nearly to boiling, dolomite will also effervesce.

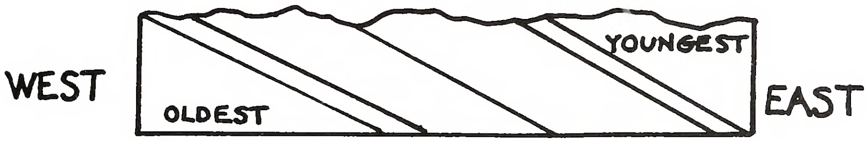
Chert (Ch.) A hard flinty material found as nodules or lenticular layers in some local limestones.

Loess A fine, brown, unconsolidated silt capping the bluffs locally.

Before describing individual formations there are two local facts that should be borne in mind.

First: The Mississippi in its course between Grafton and Alton, the area we are considering, flows *east,* not south as one usually thinks when he considers the Mississippi.

Second: The layers dip (slant) gently to the east. But the rocks have been beveled by erosion to a fairly uniform height. This results in finding the most recent rocks at road level to the east and the older ones to the west. The sketch below will help make this clear.



Section showing formations dipping eastward.

In describing the formations we will begin with the oldest, those near Grafton. This order will be easier to understand.

One word about the names that are given to geologic formations or other divisions of the rock sequence. A geographical name is usually assigned to a geologic formation based on the locality where it is well exposed and usually where it was first studied.

For example, the name Cabrian was given to very early fossiliferous rocks studied in Wales, an area which bore the early name of Cambria. But Cambrian rocks are found in

every continent. Similarly, St. Louis limestone forms much of the surface rock in and around St. Louis, Missouri, but the formation is widely distributed.

Here follow brief descriptions of local rock formations:

Cambrian. Rocks of this age are found locally only in deep wells. They do appear at the surface in a large area of the Ozark region, south of St. Louis.

Ordovician. Of the two formations visible in this area only the Kimswick can be easily identified. About 0.6 miles upstream from the entrance to Pere Marquette Park a rough-surface limestone is found on the hillside. The limestone can be identified as Kimswick if you can find a fossil which may resemble a snake skin on the surface of the rock, or sometimes, if the patch of fossil is large, it may resemble the seeds in a ripe sunflower head. This fossil is inaccurately called sunflower coral.

Silurian. The trained geologist recognizes three formations near Grafton, but they are so similar we shall treat them as one. This is a light gray color that weathers to a light tan, by which color it can be identified. It is of dolomitic composition. It forms the quarry face for some distance east of Grafton, and it is also exposed for about a mile on Highway 100 north of Grafton. The rock is excellent for building purposes.

This is the local formation where trilobites are most numerous although not actually abundant. See Appendix II. Three varieties of trilobites and two of Cephalopods are present in this formation.

Devonian. At the top of the quarries at Grafton there is a dense layer of limestone with a smooth surface perhaps six feet thick. If you find a piece that has fallen, you might find a Brachiopod in it.

Kinderhook. The remainder of the rocks to be seen all the way to Alton are of Mississippian Age. The oldest rocks of that age are called the Kinderhook group. These include five identifiable formations of shale, sandstone, and limestone. Altogether they measure less than seven feet in thickness locally. They can be seen at the south side of Highway 100 about one mile from Grafton, but it will probably take an expert to identify each formation for you.

Hannibal (Sh.) Above these forms of the Kinderhook which are difficult to identify lies the Hannibal shale. It is thin bedded and dominantly gray although at times it shows a greenish gray tone. It can be seen on the right of Highway 100 about one mile north of Grafton. It forms a shallow cave there.

It can also be seen at the base of the cliff where a rock slide once occurred about two miles east of the point where Highway 100 joins the Great River Road. Here the greenish cast is prominent.

Chouteau (Ls.) This limestone is gray colored. It overlies the Hannibal shale and can be seen above the shale at each of the two places where the Hannibal shale can be seen. At the rock slide mentioned the large slabs are Chouteau. It also forms the lowest five feet of the bluff directly west of Chautauqua.

Sedalia (Dol.) This is fine grained and buff colored. It forms perhaps ten vertical feet of the bluffs above the Chouteau and below the succeeding Fern Glen.

Fern Glen (Ls.) This forms the base of the bluffs at Chautauqua (about a mile west of Elsah) and is higher as one goes west. It is thin bedded and contains numerous small chert nodules which are characteristically of a greenish gray color. Fossils can be found although they are not numerous. If you find a fossil that looks like a tiny starfish (though it isn't) a half inch or less across with four, five, six, or more points, you are certainly in the Fern Glen formation. The fossil is called Evactinopora.

Burlington (Ls.) Burlington forms most of the bluffs for many miles east and west of Elsah. This limestone includes many layers of a flinty textured rock called chert. The chert is white, although the outside may be stained a reddish brown. This chert was used by the Indians of this area to make spear points and arrowheads.

A quarry of Burlington limestone was operated for many years in the bluff just west of Elsah. Some of the rock quarried was used for riprap along the river.

One layer encountered near the base of the quarry was very pure limestone. It paid the operator of the quarry to install a mill and grind this particular rock to a powder. This

powder could be used for a variety of purposes. It could make putty, or a cheap paint or a paint adulterant, or silver polish, or even tooth powder. It used to be said that some workmen would take a bucket of it home and use it in any or all of these ways. Practically all of the "rock houses" in Elsah are made of stone from the Burlington.

Your attention should be directed to the curious and unusual form of the bluffs where the Burlington is the dominant bluff form. Figure 6 shows the phenomenon. There are many small protruding buttes separated by rounded indentations in the bluffs.

Warsaw (Sh.) The Warsaw is dominantly shale or shaley limestone in this area. Since it is not resistant to erosion, it does not form bluffs. There is a layer sometimes not over a foot in thickness at the very top of the hard rock part of the bluffs on the central part of The Principia College campus. In this Warsaw formation a fossil called Archimedes (described in Appendix II) resembling a corkscrew may be found. Occasionally this may be completely weathered out of the rock.

The thickness of the outcrop increases eastward. East of Eliestoun on The Principia College campus it forms a slope above the Burlington bluffs, and fossils may be found in it.

Elsewhere, but not on The Principia campus, the Warsaw formation contains many geodes. These are rounded hollow masses having a shell of hard cherty material. The empty space may be lined with crystals of quartz. Rarely small quantities of other minerals may occur. Although these geodes are not common in the rocks of the college campus, geodes which have been weathered out of the Warsaw formation elsewhere are quite common in the gravel beds of some local streams. The road at the north end of Elsah which branches to the right (called the Cemetery Road), about a mile from Elsah crosses Mill Creek, which has such a gravel bed. It sometimes yields geodes.

Salem (Ls.) The Salem Ls. is found at the eastern end of the college campus. The main bluff east of Piasa Creek is also of Salem Ls. The fossils found in it are usually small.

This rock is identical in age and composition with the commercial Bedford stone which is quarried in Indiana, and

is used extensively in constructing fine buildings. The Principia Chapel is built of Bedford limestone.

St. Louis (Ls.) The St. Louis Ls. usually appears somewhat whiter than the other limestones in this area. It forms most of the quarry face at Alton where it can be seen from the Great River Road. Fossils are not very common in this formation, but there are a few layers where they may be found.

Ste. Genevieve. (Ls.) This limestone is thought by some geologists to form the top ten feet or so of the quarry at Alton. It is much thicker south of St. Louis.

Chester (Ls.) This formation is, like the Kinderhook formation, a group of variable layers indicating rather rapidly changing conditions in the sea at the time it was formed. The units of this group may be seen near Chester or Menard, Illinois, some seventy miles south of Alton.

This concludes our brief summary of the formations found in this area that were deposited during the Mississippian Era and earlier. You can see why the period was called Mississippian. The finest continuous exposure of rocks laid down during that long interval anywhere can be found in the bluffs along the Mississippi River.

For those who would find a road log useful, one has been added at the end of this appendix. It is respectfully suggested that you familiarize yourself with the names and descriptions of the formations before you try to use the road log.

Road Log of Geological Features on the Great River Road from Alton to Pere Marquette State Park, Illinois

Mileage

0.0 Alton, corner of Broadway and Piasa Sts., U. S. 67

0.1 Grain elevators of Peavey Company

0.5 See Figure III. Abandoned quarry of the Mississippi Lime Company. From here to Grafton there is an almost continuous palisade of limestone formations. The youngest are seen here. The rocks are progressively older as one goes west toward Grafton. The rock exposed in this

Figure II. Formations visible near Elsah, Illinois			
Period	Formation	Rocks visible at surface	Approximate local thickness
Pennsylvanian	Not differentiated here	Central Illinois, locally at Godfrey	
Mississippian	Chester group	70 miles south of Alton	
	Ste. Genevieve limestone	Few feet top of bluff at Alton	10
	St. Louis Ls.	Main quarry face at Alton	200
	Salem Ls.	Top of bluff at east end of Principia property	70
	Warsaw shale	Thin layer at top of campus bluff. It thickens eastward	50
	Burlington ls.	Main bluff east and west of Elsah	250
	Fern Glen Ls.	Base of bluff at Chautauqua	15
	Sedalia Dol.	Lower part of bluff just west of Chautauqua	20
	Chouteau Ls.	Bluff face above rock fall 0.7 miles west of Chautauqua	40
	Hannibal Sh.	Below Chouteau at above site. Also east side of Highway 100 one mile north of Grafton	40
	Lower Kinderhook	Obscure patches along Highway 100 north of Grafton.	10?
Devonian	Cedar Valley	6' top of Grafton quarry	6
Silurian	Niagaran	Quarry face at Grafton	100
Ordovician	Kimswick	Obscure patch north of entrance to Pere Marquette State Park	70
Cambrian		Only in deep wells	

quarry and for over a mile eastward is the St. Louis Ls. At the top of the quarry face there is a layer about eight feet thick of cross bedded limestone. That word "crossbedded" means that although the main beds are essentially horizontal, minor bedding within the horizontal bed dips. This layer is believed to be Ste. Genevieve Ls. Overlying the limestone here and all along the river there is a layer of fine brown silt called loess (pronounced luss) which was wind blown.

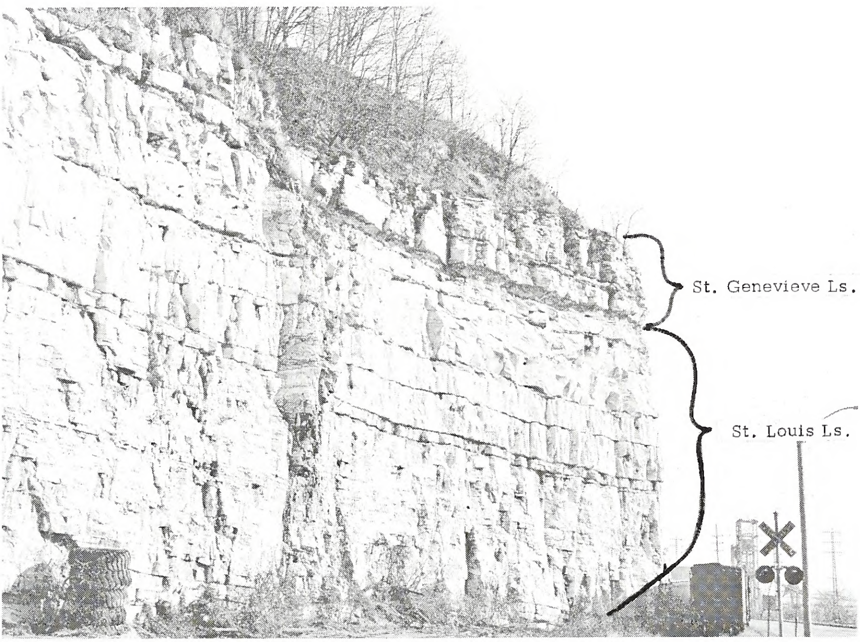


Figure III. The face of an abandoned quarry of the Mississippi Lime Company at Alton. The top ten feet or so showing at the right of the picture is believed by many geologists to be Ste. Genevieve limestone. The rest is St. Louis limestone. Indications on the figure are approximate.

0.7 See Figure IV. Sand piles dredged from the river by the Mississippi Lime Company for building material. Geologically it is called alluvium, meaning "deposited by running water." It was largely accumulated during, and more largely since, the last Ice Age.

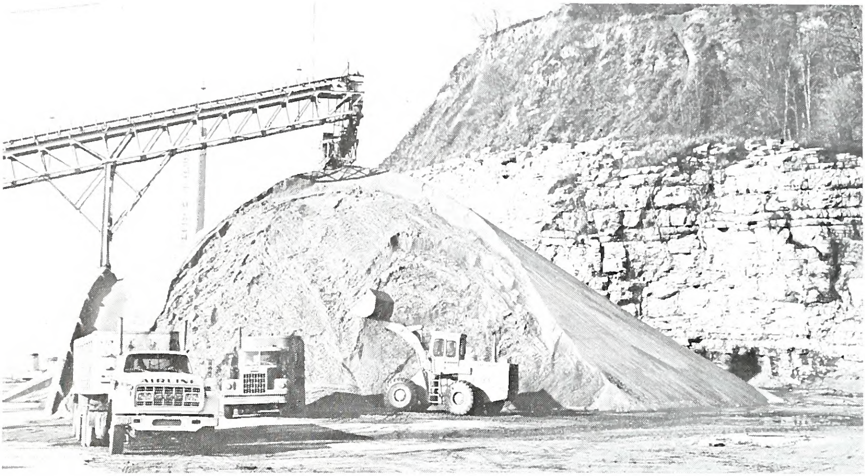


Figure IV. Sand pile dredged from the bed of the river. The quarry face is St. Louis limestone. The slope above partly obscured by vegetation is the brown wind-blown silt called loess by geologists.

0.7 See Figure V. Tunnel openings. During the latter part of the quarrying operation, underground mining was resorted to.

Figure V. In the late phases of quarrying, the quarry-men used underground mining methods. Three mine entrances can be seen.

2.4 Abandoned quarry of the Olin Company. Water is standing at the base. Here 145 feet of St. Louis Ls. overlies 4 feet of Salem Ls.

2.9 See Figure VI. Abandoned quarry in St. Louis Ls. Local talent has reproduced on the quarry face the fourth or more repetition of what is locally known as the Piasa Bird. Marquette in his journal described a painting on a local bluff of a dragon-like creature. This is undoubtedly authentic. The rest of the local belief that it was painted by Indians, and the fantastic and florid so-called Indian legend to account for it, are pure journalistic imagination. The area with its filling station is called Norman's Landing. Some repair work on barges is done here.

Figure VI. Abandoned quarry in the St. Louis limestone at Norman's Landing. The figure on the rock was painted in 1973. It is the fourth or more such painting made in the past three decades. The picture is an attempt to portray a description Marquette gave of a picture he saw on a nearby bluff in 1673.

4.5 Clifton Terrace road to the right. Remain on the Great River Road.

5.6 See Figure VII. Abandoned quarry in Salem Ls. about 60 feet thick with thin capping of St. Louis Ls.

Figure VII. Nearly complete exposure of Salem limestone (60 feet) with a thin capping of St. Louis limestone.

6.4 Bridge over Piasa Creek. The community is called Lock Haven. The road valley is underlain by Warsaw Sh. but only a small patch can be seen at one side.

10.8 See Figures VIII and IX. Elsah. Bridge over Askew Creek, and access road named Mill Street. Stay on Great River Road. The bluffs for more than three miles both east and west are dominantly Burlington Ls. The unusual way this cliff has been eroded into small projecting buttes and alternating hollows is well shown in Figure VIII.

11.0 Abandoned quarry in Burlington Ls.

12.4 See Figures X and XI. Bridge at Chautauqua, a private summer resort. The bluff to the east shows these formations (Figure X): 20 feet or more of loess; Burlington Ls. to the top of the bluff; 16 feet of Fern Glen Ls., thin bedded and very cherty; 3 feet of Sedalia Dol. if not covered by talus.

Figure VIII. Conspicuous example of curious erosion of the Burlington limestone near Elsah. The headlands or buttes project with rounded hollows between. There seems to be no unanamous opinion as to what caused this. This picture was taken about 1930 before the Great River Road was made and before The Principia College campus was completed.

Figure IX. The Mississippi River seen from the top of the bluffs at Elsah. The view is downstream essentially eastward. The top of the Burlington limestone bluff can be seen at the lower right. The grass-covered slope above it is composed of the brown, wind-blown silt called loess.

The bluff to the west shows these formations (Figure XI): 20 feet or more of brown loess; 70 feet of Burlington Ls. to the top of the bluff; 16 feet of Fern Glen Ls., thin bedded and cherty; 20 feet of Sedalia Dol.; and 5 feet of Chouteau Ls.

Comparison of these two sections enables one to see to what extent these beds dip to the east.

Figure X. The bluff east of Chautauqua shows, from the bottom up, 3 feet of Sedalia Dolomite, almost covered by vegetation; 16 feet of thin-bedded cherty Fern Glen limestone, and above that Burlington limestone. Indications on the figure are approximate.

13.2 See Figure XII. Several large slabs of Chouteau Ls. have fallen from the bluff above due to the insecure formation of the underlying Hannibal Sh. This shale is slippery when wet. The bluff above the greenish gray Hannibal Sh. shows a sequence of Chouteau, Sedalia, Fern Glen, and Burlington.

13.2 The confluence of the Illinois and Mississippi Rivers is visible here. Looking upstream, west, one sees the Illinois River flowing almost due east. Across the water the

Figure XI. The bluff west of Chautauqua shows, from the bottom up, 5 feet of Chouteau limestone; 20 feet of Sedalia limestone; 16 feet of Fern Glen cherty, thin-bedded limestone (the base marked by conspicuous indentation); 70 feet or more of Burlington limestone capped by brown loess. Indications on the figure are approximate.

Mississippi flowing northeast at this point joins the Illinois.

13.6 Broad valley called Powder Mill Hollow. There used to be a nitroglycerine plant located back in one of the narrow tributary valleys. Nitroglycerine is used in some oil wells to increase the flow of oil. Nitroglycerine is also made into dynamite.

14.2 See Figure XIII. Quarry near Grafton. The lower part of the quarry face is Silurian Dol. It weathers to the light tan color seen, but it is gray on a fresh surface. Many local buildings are made of this rock which has excellent properties appreciated by a stone mason. The stone butments of Eads' Bridge used rock from this quarry. The bridge, completed in 1874, was the first to cross the Mississippi in this area.

Figure XII. Several slabs of Chouteau limestone in the foreground cover a section of greenish gray shale, the Hannibal shale, and above this the Chouteau, Sedalia, Fern Glen, and Burlington limestones--a very complete section.

At the top of the bluff in some places one can see a layer about six feet thick which contrasts with the lower rock by appearing finer grained and smoother. This is the total thickness of Devonian rock in this area. The overburden here as elsewhere is the fine wind-blown silt called loess by geologists. I have found a few pebbles of igneous rocks that have fallen from the top of the quarry. These pebbles indicate that melt-water from the Third Great Ice Sheet carried pebbles. The pebbles would naturally lie between the top of the Devonian and the overlying loess.

15.0 Grafton. Highway 100 enters the Great River Road from right. Do not turn.

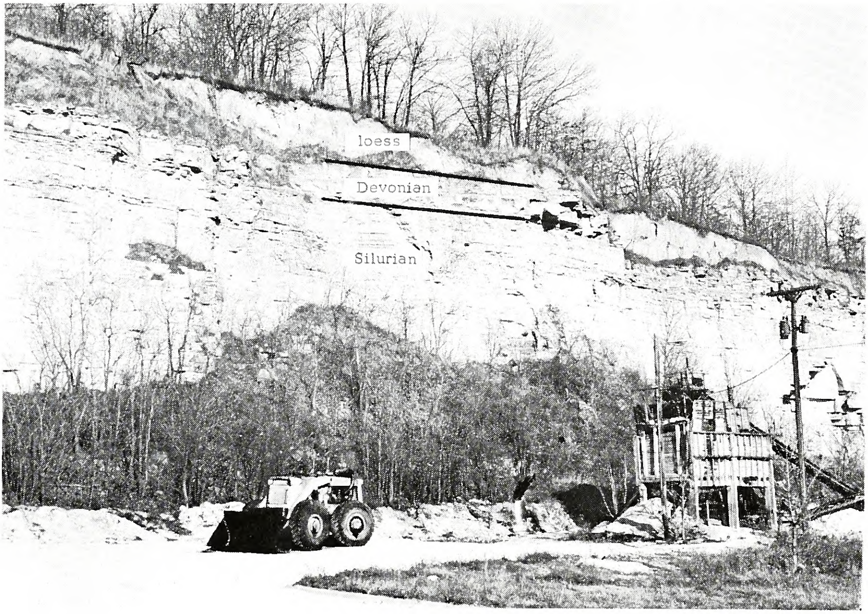


Figure XIII. The quarry at Grafton. The rock is of Silurian age except for a thin layer, 6 to 8 feet thick, at the top of Devonian. L ess covers the cliff. Indications on the figure are approximate.

15.1 Former residence of Dr. Gideon Dempsey. The garden wall and rock garden are made of geodes which have weathered out of the Warsaw Sh. Dr. Dempsey and his family spent several years in collecting them from stream gravels.

16.6 Entrance to Marquette State Camp for Boys.

16.7 See Figure 14. The large stone cross on the right marks the site of Marquette and Joliet's first campsite in Illinois on their return trip of exploration in 1673.

18.1 Brussels' ferry to Calhoun County. Continue on the Great River Road.

21.1 Entrance to Pere Marquette State Park.

21.3 Back in the trees and underbrush one can find steeply dipping limestone beds. Our route has been crossing one of the rather few places where the rocks have been sharply deformed. Study shows this rock to be St. Louis Ls., the same as we saw in Alton. The reader is left to his own conclusions.

Figure XIV. Monument marking the first reported campsite of Marquette in Illinois on his journey northward in 1673.

Appendix II -- Fossils

This section is added for those who wish to make a start in identifying the fossils found in the rocks we have described. Several guidebooks to fossils have been published. Probably the best for this area is published by the Illinois State Geological Survey, Urbana, Illinois: *Guide for Beginning Fossil Hunters in Illinois,* by Charles W. Collin-

son. For those who would like a very simple guide to the local fossils, the following is offered.

Finding fossils in the rocks is an exciting experience. They have a fabulous story to tell to all who can learn to listen. They are not abundant in any local rocks, but they reward diligent search. Figure XV shows pictures of several types of fossils that are found in this area. The numbers in this text correspond to the numbers in the figure.

1. Corals are white, cone-shaped, with a deep depression in the base of the cone. If you find a perfect one you will see many very thin partitions radiating from the center of the base. Quite frequently many corals live together and cones are crowded in small colonies resembling honeycomb. They are sometimes called honeycomb corals.

2. Crinoids at first glance look somewhat like plants but they are a low form of animal. They have a top that vaguely resembles a lily. A long stem anchors them to the sea bottom. They are made of countless bead-like disks fitted together.

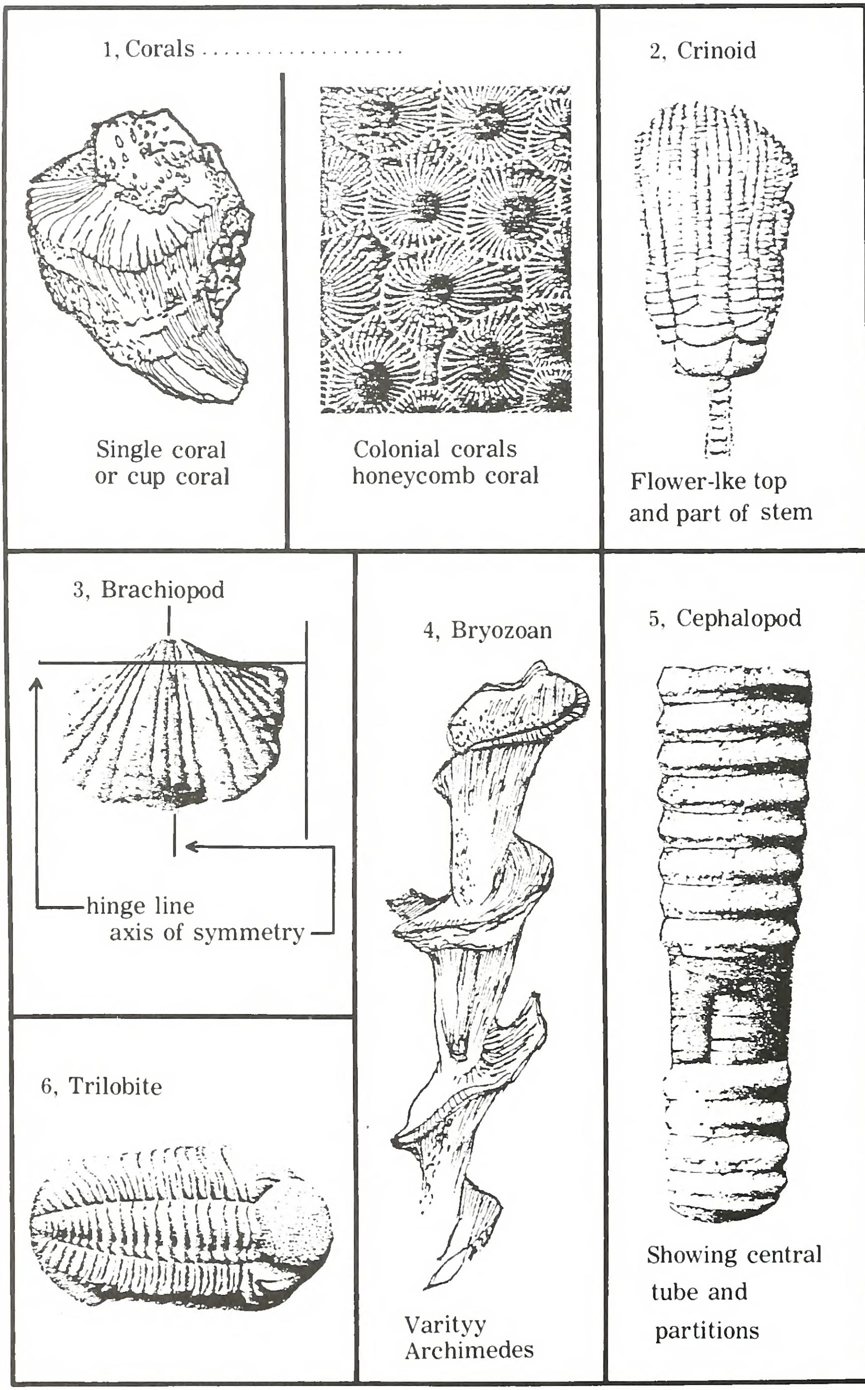
When the animal dies, the beads usually separate. Some local limestone rocks seem to be made almost exclusively of countless such beads. The Indians sometimes found these beads weathered out of the rock and used them for wampum.

Only rarely are entire flower-like heads preserved intact. But when they are found they are among the most prized fossils in this area. A large bed of very perfect crinoids was discovered late in 1973 near Waterloo, Illinois. Fragments of the stems which are round disks are very common and anyone can find them with a little search.

3. Brachiopods have two parts hinged as in the case of a clam or oyster shell. However in brachiopods each individual valve (or shell) is symmetrical. By this I mean if you think of dividing a valve by a line perpendicular to the middle of the hinge, the halves will be mirror images of each other; one side will resemble the other in the same way that your right hand resembles your left.

Brachiopods are found in a variety of shapes. They constitute one of the most common fossils around here

Figure XV. Common local fossils



except the individual disks of the crinoids.

4. Bryzoans occur in countless forms, far more numerous than one can describe in this short paper. But the one that fascinates the beginner most, and is fairly common in local rocks, resembles a cork screw. It is called Archimedes after the ancient Greek philosopher who used a device shaped something like this to pump water.

5. Cephalopods (pronounced ceph-a-la-pad), the early forms of which are common locally, are shaped like a baseball bat. The interior is divided into separate compartments from end to end by very thin layers of shell. These compartments are connected by a slender tube. These interior features are not generally seen in the fossils that can be found in this area. The entire fossil is not rare but one usually finds only a fragment a few inches long. However, I once saw a Cephalopod six feet long and six inches in diameter. It must have been one of Babe Ruth's or Hank Aaron's ancestors used and lost many million years ago.

Several small Cephalopods have been found in the Grafton Quarry. One about eighteen inches long can be seen in the sidewalk of the Christian Science church in Elsah.

In times much later than when local rocks were formed these straight forms became coiled. The well known pearly nautilus is a modern descendent.

6. Trilobites have a very faint resemblence to a crayfish or lobster. They are divided into three parts from front to back (abandoning all scientific jargon) that appear to be a head, a body, and a tail, the latter usually being stubby. They are also divided longitudinally into three lobes, a middle one and two side ones, hence the name tri-lobite.

Of all the fossils mentioned that can be found in the rocks at Elsah, the trilobite, I believe, is the rarest. I do not recall that I have found a half dozen on the Principia campus in the many years that I have been collecting. Trilobites used to be quite common in the Grafton quarry but lots of rock hounds know it and one has to collect shortly after blasting has opened up fresh rock.

ABOUT THE AUTHOR

Percival Robertson was born in New Haven, Connecticut, and had his early education there. His undergraduate study was done at Yale University, from which he received a PhB degree in 1915. His graduate study, done at Washington University, and the University of Colorado and University of Chicago during summer quarters, led to MS and PhD degrees. His fields of study included mining engineering, chemistry and geology.

When Dr. Robertson joined the Principia faculty in 1915 as a mathematics teacher, he began to build up the natural science department and was soon made chairman of the departments of chemistry and geology.

He has held membership in a number of learned societies, some of which are the American Association for the Advancement of Science, the American Chemical Society, the St. Louis Academy of Science, the Missouri Academy of Science, and the Illinois Academy of Science, and in addition he served as a member of the board of the Illinois State Museum Advisors. He has held office in several of these societies. The list of papers and articles contributed by Dr. Robertson to various publications is very long.

Dr. Robertson was named Professor Emeritus of Principia College and was awarded a Doctor of Laws honorary degree from Principia. His official retirement came in 1955, though it was retirement in name only, as he very soon filled a temporary post in the geology department of Duke University and later on served at Claflin College, Orangeburg, South Carolina.

Historic Elsah Foundation is especially grateful to have this leaflet written by someone not only eminent in his field and intimately familiar with the subject he is discussing, but as much a part of the history and development of Elsah during the twentieth century as anyone.